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Performance of a 2.5 THz Receiver Front-End for Spaceborne Applications

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The OH radical plays a significant role in a great many of the known ozone destruction cycles, and has become the focus of an important radiometer development effort for NASA's Earth Observing System Chem I satellite, which will monitor and study many tropospheric and stratospheric gases and is scheduled for launch in 2002. Here we describe the design, fabrication, and testing of a receiver front end used to detect the OH signals at 2.5 THz. This is to be the first Terahertz heterodyne receiver to be flown in space. The challenges of producing the necessary high-performance mixers are numerous, but for this application, there is the added challenge of designing a robust receiver which can withstand the environmental extremes of a rocket launch and five years in space.

The receiver front-end consists of the following components: a four-port dual-polarization diplexer, off-axis elliptical feed mirrors, mixers for horizontal and vertical polarization, support structures allowing simple and rugged alignment, low noise IF amplification from 7.7 to 21.1 GHz, and mixer DC bias circuitry. The front-end design, alignment, and operation will be covered in depth, followed by a discussion of the most recent results in receiver noise and dual-mode horn beam patterns. JPL MOMED mixers are employed, and have resulted in receiver noise temperatures of 14,500 K, DSB with LO frequency 2.522 GHz and IF of 12.8 GHz. Horn beam patterns correspond well with theory, with no significant sidelobes above the –25 dB level. Considering the high-quality beam of this receiver, these results are competitive with the best reported in the literature.